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## NOTES ON PHYMATODES VULNERATUS LEC. WITH A NEW HOST RECORD (COLEOPTERA, CERAMBYCIDAE).

BY HUGH B. LEECH,

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Early in 1928, at Salmon Arm, B.C., a thirty foot tree of Vine Maple (*Acer circinatum* Pursh.) which had been dead for three years, was found to be infested with Cerambycid larvae. Accordingly the tree was felled, cut into two-foot sections, and portions from six inches to half an inch in diameter were put into a wire-screen cage under as natural conditions as possible, and in the shade. As it happened, this shady position seems to have been well chosen, as of seventeen infested maples examined during 1928-1929 only two occurred in the sun.

The first beetle emerged on May 13th and by May 26th nineteen adults were out. These were identified for me as the Scarwinged Longhorn, *Phymatodes vulneratus* Lec. by Mr. Ralph Hopping of Vernon, B. C. to whom I am grateful for much assistance.

The beetles were allowed to remain in the cage to permit of egg-laying. They were not fed in any way. The females oviposited freely from about 10 a.m. to 4 p.m. for five days; the whole series was then killed and pinned.

The cage and the sections of wood were left intact for a year. On May 20th, 1929, the first adult of the second brood emerged, and within the next eight days thirty-four had appeared. The beetles copulated freely, and egg-laying was observed on the third day, though it may have occurred previously. The process was more carefully noted at this time.

The gravid female would choose a convenient exit hole in the maple wood, and then reach her ovipositor as far down as possible, feeling carefully for a roughened section on which to lay the egg. Each egg was placed separately; from one to three were found in the burrows examined, two being the usual number. As all the specimens were very active, either running or flying around the cage both before and after copulation, it is very unlikely that any female managed to lay in the exit of her own tunnel.

The reproductive instinct appears to be very strong with this species. Half a dozen males and as many females were taken from the cage on the day that they emerged, and put into a glass covered tin box, four inches in diameter. Although the box was not in bright light the beetles were very active, and seemed interested only in copulation. Individuals would run around quickly for perhaps fifteen seconds, then would keep still for a moment unless disturbed by another. It seemed to the observer that the females were the most active, and always pursued the males, rather than vice versa. Further verification on this point is necessary however, before a definite statement can be made. The males were inclined to be pugnacious, and several legs and antennae were damaged during the three hours that the beetles were in the tin box.

The side and particularly the darker part of the box attracted the insects most. As soon as put in, they arranged themselves around the circular side; if disturbed and forced to the bottom, they very quickly returned to the side. This seems quite natural when one considers their habit of scuttling around the sloping or vertical trunk of a tree. The adults, when resting on the wood sections in the cage, always preferred the side of a non-horizontal limb to any other. I note however that a limb being horizontal was by no means enough to prevent a female from ovipositing.

PHYMATODES VULNERATUS LEC. IN WILD ROSE (*Rosa nutkana* Presl.)

I believe this to be a new host record for the species. On May 12th, 1929, several sections of a dead bush of *Rosa nutkana* Pres. were noted as being infested. Sections were cut, and caged under conditions the same as those mentioned for the maple.

Emergences started on May 20th. The specimens from *Rosa nutkana* Presl. were all rather light in color, while those from *Acer circinatum* Pursh. showed a nice series, ranging from almost black on the basal halves of the elytra, to light chestnut.

In both the maple and the rose, even in the smaller branches, there was but a single burrow in any way connected with a pupal cell.\* The rose wood was three quarters of an inch to one inch in diameter, and the pupal cells were not more than an eighth of an inch from the surface. In the maple, on the other hand, the chambers were on the average from one quarter to one half an inch below the surface, depending on the size of the wood. The comparatively large pith area in the rose was probably the chief factor in determining the location of the cells there, as none of the tunneling was continued even to the edge of the pith.

THE TOADHOPPERS OF THE GENUS PHYLLOSCELIS GERM.  
(RHYNCHOTA FULGORIDAE).

BY E. D. BALL,

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The insects of this genus are all North American and are strikingly distinct from all other forms in this region in their almost hemispherical outline and leathery opaque elytra. Although they jump with great agility, when seen strutting about on their broadly foliaceous legs they appear awkward and grotesque in the extreme. They rest on the stems of the shrubs head upwards and the body inclined outwards at about a 30-degree angle. When they leap it is with such speed that the human eye cannot follow them but they must spring away from the plant almost bottom up and it is possible that the broad leaf like membranes on their fore legs serve as rudders to guide their flight and finally land them right side up. A number of different genera in the Fulgoridae have foliaceous expansions on the fore legs and most of them agree in being heavy bodied and short winged, a combination that might easily use a gliding surface for orientation purposes. A light-bodied long-winged insect would not need such a device, as its initial jump need be only far enough to clear the foliage and give it an opportunity to open its wings.

\*—c.f. Hardy and Preece, in the Pan-Pacific Ent. for April, 1927, page 190.

Germar recognized two species in the group, a black one (*P. atra*) and a gray one (*P. pallescens*) and all subsequent writers have followed him in this matter. When the writer began to collect in this group in Florida he soon discovered that he was taking black forms mingled with reddish-brown ones on one food plant and black forms intermixed with striped ones on several other plants. A careful study indicated that two strikingly distinct species each with a black form were being confused. Later examination of a number of the larger collections established the fact that both species were widely distributed in collections but all under the name *atra* Germ.

KEY TO THE SPECIES OF PHYLLOSCELIS Germ.

- A —Apical third of elytra with 3 or 4 longitudinal nervures ..... 1. *atra* Germ.
- AA—Apical third of elytra with 8 or more longitudinal nervures.
  - B —Elytra reddish or black, nervures concolorous; anterior tibiae definitely expanded in the middle ..... 2. *rubra* nov. sp.
  - BB—Elytra pale; nervures narrowly dark interrupted with white flecks; anterior tibiae slender, margins parallel ..... 3. *pallescens* Germ.

1.—*Phylloscelis atra* Germ.

Globose, elytra leathery with three longitudinal veins on the corium, the outer one obscure, the inner one broadly forked beyond the middle. These veins sometimes fork again just before the apex. Anterior femora extremely broad and foliaceous towards the apex, abruptly narrowing before the base. Anterior tibiae slender, parallel margined. Length 4-6 mm.: width 3 mm. This species is distributed from southern New York to Florida and west to Kansas, Texas, and Mexico. It appears to be limited to the warmer and more humid regions and does not occur on the typical short grass plains. The writer has taken the nymphs and adults from a number of species of shrubs of the families *Ericaceae* and *Vacciniaceae* growing in damp grass lands. The various shrubs that used to be placed under the genus *Andromeda* appear to be favorite hosts in Florida. Two generations were found there, the nymphs appearing in May, the adults in June and running on into July. The second brood nymphs appeared in August, the adults in September running on into October.

Dozier states that all (2) members of the genus are grass feeders but in all the writer's many years of collecting they have never been taken on pure grass stands, but only where clumps of shrubs occurred. The above shrubs are, however, normally found in damp grass lands.

KEY TO THE VARIETIES OF *P. atra* Germ.

- A —Black shining the nervures concolorous ..... 1. (typical) *atra* Germ.
- AA—Elytral nervures rather broadly pale or saffron.
  - B —Pronotum and elytra dark brown, the nervures narrowly saffron ..... 2. var. *ocala* n. var.
  - BB—Pronotum saffron, elytra with the nervures broadly saffron ..... 3. var. *albonervosa* Mel.

*P. atra* var. *ocala*. n. var.

Resembling typical *atra* in form and size and var. *albonervosa* in general pattern but much darker, intermediate between *albonervosa* and typical *atra* in depth of color. Front, vertex and pronotum brown, scutellum sulfur yellow. Ely-

tra dark brown with most of the longitudinal nervures narrowly banded with saffron.

*Holotype* ♀ Sanford, Florida, 10-30-26, (E. D. Ball), *allotype*, ♂ Fairfax, Virginia, Aug. 30, 1924 (Ball). *Paratypes* Sanford, Florida, (Ball & Stone) Miss. (Drake) and Onaga, Kansas. (Crevecoeur). This variety is not as common as the black forms or the pale *albonervosa* forms. In general appearance this variety is dark with narrow light nervures while *albonervosa* is pale saffron yellow with narrow dark lines between the nervures.

### **Phylloscelis rubra n. sp.**

Size and general form of *atra* with the elytra slightly longer and more inclined to be flaring. Reddish brown with the nervures concolorous. The two inner nervures of the corium forking and rejoining to form an anastomosing network of eight or ten longitudinal veins before the apex. Anterior femora even more broadly foliaceous than in *atra*. The expanded margin extending to the base, anterior tibiae narrowly but very definitely foliaceous middle femora expanded about as in *atra*, length 5-6 mm., width 3 mm. *Holotype* ♀, *allotype* ♂, and eleven *paratypes*, Sanford, Florida, 6-22-27, (Ball and Stone) and 5 *paratypes* Sanford, July 18-27, (Ball, Stone & Reaves).

These examples were all taken feeding exclusively, both nymphs and adults, on a small shrubby heather (*Xolisma fruticosa* Mich.) that grows in relatively damp pine lands. Although this plant was often found growing in mixed clumps of the shrubs given as food plants of *atra* above, this species was never taken on the other shrubs unless the clumps had been disturbed. This species has also been taken by the writer at Seabring, Ft. Meyer and Mt. Dora, Florida, and examples have been examined from various places along the Atlantic and Gulf coast, from Gulfport, Miss. to New York. As mentioned above, most of the larger collections have many examples of this species mixed with those of *atra*. Sirrene and Fulton<sup>1</sup> discuss the cranberry toad bug at length under the name *P. atra* giving details of egg lying, feeding and the consequent injury to the cranberry plants, on Long Island New York. They found a single generation with the nymphs in July and adults in August and September. Their descriptions and figures were evidently all taken from this species and not *atra* as they show the eight or more nervures in the elytra, the expanded front tibiae, and mention the reddish color and other characters typical of this species. They record the species as feeding exclusively on cranberries in that region. Schammel<sup>2</sup> repeats much of the above and records it from the New Jersey bogs. His fig. 29 shows the multiple nervures and the expanded tibiae and is clearly of this species. Just how many of the other references to *atra* are really to this species cannot be determined but if one is to judge by the collections more than half of them have been. No examples of this species have been seen from regions away from the Atlantic Coast and it will likely be found to be limited to low damp meadow and bog conditions.

### **P. rubra var. nigra n. var.**

Size and form of typical *rubra* color of typical *atra*. Black shining, with the oblique white bands below the antennae and two spots on the outer margin of the anterior femora and a band beyond the middle of the anterior tibiae white.

1.—Bull. 377 Geneva, New York Experiment Sta. (p. 383 to 404 in Annual Rep.) 1914).

2.—U.S. Farmers' Bul. 860, p. 33-34, fig. 29 1917.



Holotype ♀, allotype ♂, and 3 paratypes, Sanford, Florida, July 18, 1927, 10 paratypes, Sanford, Florida, June 22 and Sept. 19, 1927, all taken by Ball, Stone & Reeves—on the same host as the species. This variety also occurs in all large collections examined with the same limitation to the Atlantic coast

**Phylloscelis pallescens** Germ.

Size and general form of *atra* but with the venation as in *rubra*. Globose, pale grey, elytra pale, irrorate with brown points, the nervures darker interrupted with white flecks. Anterior femora broadly foliaceous, the tibiae slender and parallel margined.

This species has almost the same distribution as *atra* but is much rarer in collections and the food plant has not been recorded. The writer took a single female from an *Andromeda* in Florida. This species has the venation of *rubra* but the anterior tibiae are slender as in *atra* and the front is tricarinate.

NOTES ON THE PITYOPHTHORINAE (COLEOPT. IPIDAE)\*  
I. DESCRIPTION OF NEW SPECIES.

BY K. E. SCHEDL,  
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**Pityophthorus aplanatus** n. sp.

*Description of the adult female.* Dark brown in colour; 2.00 mm. long, 2.62 times as long as wide, allied to *ponderosae* Blackm.

*Front* of the head *plano-convex* below, closely, moderately finely punctured, coarser and sparsely on vertex, the interspaces between the punctures minutely reticulate; longitudinal carina moderately strongly developed and elevated, extending from the slightly arcuate epistomal margin up to a level of the upper angle of the eyes; indistinctly clothed with short yellow hairs. *Eyes* rather finely granulate, widely and deeply emarginate on the inner side. *Antennae* lighter in colour, club only slightly shorter than the scape (9:10), and 1.40 as long as wide, first suture nearly straight, second very weakly, third strongly arcuate.

*Pronotum* 1.04 times as wide as long, posterior margin sinuate, posterolateral angles rounded, sides arcuate, moderately constricted in front of the middle, moderately broadly rounded in front; anterior margin with 8 subequal serrations, only very slightly longer near the median line; anterior area with serrations moderately developed, rather irregular in arrangement except around the summit where they are arranged in complete concentric rows, interspaces minutely rugosely punctured between the asperities, especially in front; summit high, transverse impression broad, distinct; posterior area deeply, rather coarsely punctured, distinctly finer at the sides; median line wide, smooth, slightly elevated.

*Elytra* as wide as the pronotum, the sides subparallel, widest shortly behind the middle, broadly rounded behind; surface shining, striae not impressed except the sutural striae which are feebly so, striae punctures somewhat irregular and fine, interspaces feebly rugose, more noticeable at the sides; *declivity* abrupt, shining, minutely reticulate; punctures of striae 1 and 2 obsolete; the suture shallow and wide, rising gradually laterad to the feebly developed lateral convexities

\*—Contribution from the Division of Forest Insects, Entomological Branch, Department of Agriculture, Ottawa.

which are not granulate; pubescence very fine and indistinct, a little longer on the sides and on the margins of the declivity.

There are but slight differences which may indicate the sexes. What is believed to be the male has the carina of the front somewhat more strongly developed.

*Holotype*.—♀ Athabasca Falls, Alta., (J. M. Swaine) July, 1919. No. 3132 in the Canadian National Collection, Ottawa.

*Paratypes*.—5, same data.

*Proventriculus*. Proventricular plate 2.05 times as long as wide, 2.9 times as long as the anterior plate, anterior plate with 5 distinct and 1 reduced row of low scale-like teeth; chitinization of the anterior plate widely emarginate up to half of the length, inner angles broadly rounded.

*Penis*. General form as illustrated in fig. A. Laminae ventrales and dorsales separated by a deep emargination caudad; the laminae ventrales narrowly separated by a membrane; the laminae dorsales touching each other at the dorso-caudal angles, widely separated anteriorly, both laminae moderately chitinized and with sensory pores, those more numerous on the caudal margins, sparse in the caudal two-thirds and absent in the cephalic third; radii very heavily chitinized; the membrane connecting the dorsal margins of the laminae dorsales and the radii slightly chitinized dorsally; the jugum band-like, moderately chitinized; the parameren ring-like, broader near the metula, (tegmen furcae Fuchs), metulae short, knob-like, spiculum ventrale as long as the penis, strongly forked caudad; pediculi penis half as long as body, slender, narrowly separated cephalad.

#### ***Pityophthorus varians* n. sp.**

*Description of the adult female*.—Dark reddish-brown in colour, 2.02 mm. long, 2.67 times as long as wide, allied to *P. tumidus* Blackm.

*Front* of the head plano-convex, finely densely punctured, with a slight indication of a longitudinal carina just above the epistomal margin and with sparse, short, fine inconspicuous yellow hairs. *Eyes* finely granulate, feebly emarginate on the inner side, emargination about one-third as deep as wide. *Antennae* lighter in colour. scape and club of the same length, club 1.31 times as long as wide, widest through the second segment, first two sutures moderately, third strongly arcuate.

*Pronotum* as wide as the elytra, as long as wide, weakly sinuate behind, postero-lateral angles rounded, sides broadly arcuate behind the middle, strongly constricted in front of the middle, moderately broadly rounded in front; anterior margin with low, subequal, feebly developed serrations, anterior area with serrations low, broad, in broken concentric rows, interspaces rugosely punctured, opaque; summit high, transverse impression posterior to it distinct; posterior area coarsely, closely punctured, similar at the sides, interspaces smooth, shining; median line smooth, narrow, elevated, not reaching the base.

*Elytra* 1.65 times as long as wide, subparallel, widest shortly behind the middle; first striae distinctly impressed except near the base, others not at all, striae punctures somewhat confused, on the disc, punctures small and deep, becoming reduced to obsolescent near the declivity, interspaces rather strongly rugose on the disc, interstrial punctures small and numerous near the base; declivity abrupt, suture moderately elevated and moderate in width; sulcus shallow, grad-

usually descending from suture, subshining, finely reticulate, punctures of striae 1 and 2 greatly reduced; lateral convexities low, broadly rounded; suture and lateral convexities with small setose granules.

*Male* slightly stouter, the longitudinal carina on the front toothlike, developed below, sulci slightly deeper. The development of the front carina varies considerably.

*Holotype*.—♀, Truro, N.S., June 29, 1914, No. 235 s-1. No. 3133 in the Canadian National Collection, Ottawa.

*Paratypes*.—6, same data.

*Proventriculus*. Proventricular plate 2.77 times as long as wide, 2.90 times as long as the anterior plate; anterior closing teeth as long as the anterior plate, weakly serrate on the externo-lateral side; anterior plate with 4 distinct rows of low, blunt, scale-like teeth, also one reduced.

*Penis*. General form shown in fig. B. Laminae ventrales and dorsales fused laterally and caudad; the former narrowly separated by a membrane ventrally, the latter similarly separated as in *applanatus* n. sp.; sensory pores on the caudad portion of the laminae ventrales and on the caudal margin of the laminae dorsales; both laminae moderately heavily chitinized; the radii very heavily chitinized and projecting over the caudal margins of the fused laminae; the membrane connecting the laminae dorsales and the radii dorsally developed into a heavily chitinized stick which is forked towards the radii; it extends beyond the parameren where it is bent, recurved, making a loop, the extreme end of which projects over the caudad margin of the laminae; the ventral half of this structure is a band, the margins of which are turned up most probably to receive the seminal rod; this structure is believed to be homologous to the "*Rinne*" (Fuchs) as it occurs in *Pityogenes* Bedel and *Ips* deGeer; for future investigations the preliminary name, *sulcus seminalis*, is proposed; the parameren are wide, ring-like, the tegmen furcae (Fuchs) wide, for half of the width of the ring; pediculi penis 0.75 times as long as the body, slender, touching each other cephalad; spiculum ventrale as long as the whole penis, slender, forked caudad, second spine medium long.

### ***Pityophthorus watsoni* n. sp.**

*Description of the adult female beetle*. Dark reddish brown in colour, with summit of the pronotum usually lighter; 2.22 mm. long, 2.89 times as long as wide; allied to *P. solers* Blackm.

The *front* of the head plano-convex on more than a semi-circular area, rather finely, closely punctured, with fine rather short hairs of nearly uniform length, forming a sparse brush below, more coarsely and sparsely punctured above; eyes moderately finely granulate, the emargination wider than deep; *antennae* lighter in colour, club 1.33 times as long as the funicle, 1.28 times as long as wide, the first two sutures nearly straight, the third strongly arcuate.

The *Pronotum* 1.18 times as long as wide; the posterior margin broadly curved, sides nearly straight and subparallel on the posterior half, distinctly constricted in front of the middle, rather broadly rounded in front; the anterior margin with very low and weak serrations which are not visible when viewed from above; asperities on the anterior area low, rather feebly developed, not fus-

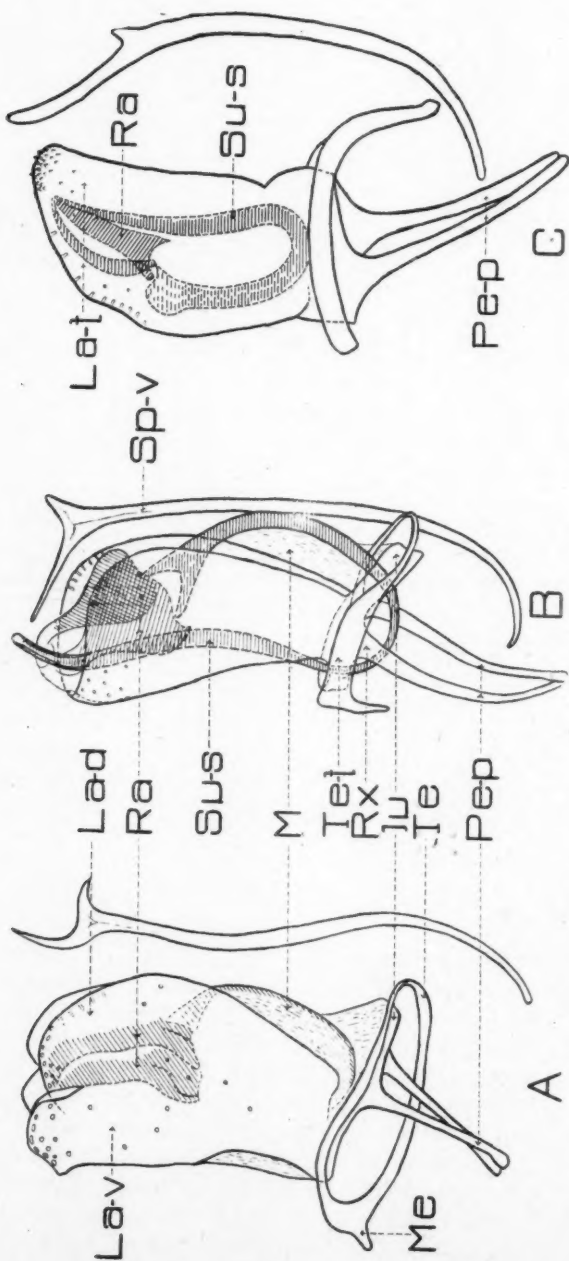


Fig. A. Peres, lateral aspect; *Pityophthorus applanatus* n. sp. B. *Pityophthorus curians* n. sp.; C. *Pityophthorus auloni* n. sp.; Ju, jugum; M, membrane connecting the dorsal margins of the laminae dorsales; Me, metula; La-d, laminae dorsales; La-v, laminae ventrales; La-t, fused laminae dorsales and ventrales; Ra, radius; Rx, radix; Sp-v, spiculum ventralis; Su-s, sulcus seminis; Te, tegmen or parameren; Te-f, Tegmen furcae; Um, umbellicus.



ed at their base to form concentric ridges, not very closely placed near the summit as in *P. solers* Blackm.; summit moderately high, transverse impression weakly developed; posterior area shining, rather sparsely, finely and deeply punctured; median line impunctate, feebly elevated anteriorly, lateral impunctate area (in the female) present; posterior marginal line fine but distinct and continued at the sides to a point anterior to the forelegs. *Elytra* distinctly wider than the pronotum, widest before the middle, 1.85 times as long as wide; the sides subparallel, slightly tapering behind, acuminate at the apex; surface of the disc shining, subrugulose; and subglabrous; first striae feebly impressed, others hardly so, stria punctures moderate in size, in regular rows, moderately closely placed; interspaces moderately narrow, rugulose, especially near the suture, sparsely punctured; ninth interspace hardly elevated; scutellum elongate rectangular; *declivity* oblique; sulci moderately wide and deep, shining; suture rather wide, strongly elevated, with a row of small setose granules; punctures of first and second striae reduced but distinct; lateral convexities as high as the suture with small setose granules.

The male is usually slightly larger and stouter; the sculpture of the pronotum and elytra are distinctly coarser; the declivity and lateral convexities as in the female except the granules which are usually slightly coarser; the apex less acuminate; the frons is plano-convex below, densely coarsely punctured with a faint indication of a longitudinal carina and a transverse carina which sometimes shows a caudal extension.

*Holotype*, ♀, bears the label, Nictor Lake, N.B., 9-VII-1921, Red spruce, M. B. Dunn, No. 3167 in the Canadian National Collection, Ottawa.

*Allotype*, ♂, same data.

*Paratypes*, 2 females, 2 males, same data, 2 females also from Frater, Ont., 8-VII-1925, *Picea canadensis*, E. B. Watson, Coll.

*Proventriculus*. The proventricular plate 2.1 times as long as wide, 3 times as long as wide, 3 times as long as the anterior plate; masticatory brushes diverge at about four sixth of their length; anterior closing teeth about as long as the anterior plate, serrate on the externo-lateral side; femoral teeth absent; anterior plate deeply emarginate, with five distinct rows of low, blunt, scale-like teeth; median elevation smooth.

*Penis*. The laminae dorsales and ventrales fused at the sides, the chitination more heavy on the dorsal portion and towards the apex; the basal two thirds of the fused lamina tubelike, cylindrical, in the apical third the laminae dorsales slope gradually towards the ventro-caudal angles of the laminae ventrales, apex rounded; near the dorsal margin of the laminae dorsales occur a few sensory punctures, the apex of the fused lamina is densely covered by sensory papilla; dorsally and ventrally the two fused lobes are connected by a membran; the radii are long, elongate with a recurved extension, the sulcus seminalis well developed similar as in *P. varians* n. sp. but extends cephalad not beyond the jugum; the jugum more heavily chitinated, extending far beyond the laminae dorsales, the connection with the laminae semimembranous; pediculi penis 0.70 times as long as the body, rather narrow, radix moderately wide; tegmen ring-shaped, moderately wide, metula very long, knob-like at apex; the tegmen furcae as wide as the rest of the parameren; spiculum ventrale nearly as long as the whole penis, slender, with a short branch caudal.

## A PRELIMINARY SURVEY OF THE COLLEMBOLA OF IOWA.\*

BY HARLOW B. MILLS,

Ames, Iowa.

The following survey is based on collections made in Iowa from March, 1929 to February, 1930. It is not all-inclusive, as intensive collecting was carried on in only a very small area in central Iowa, in the vicinity of Ames. It is hoped however, that the list will be of value in extending the limits of distribution of several species.

Some forms are represented by only a very few specimens but there is no doubt that further collecting will reveal a much more general distribution over the state than the following records show. Collections were made by the author unless otherwise stated.

Acknowledgement is due to Prof. J. E. Guthrie for loan of valuable literature, collection records, and access to a large determined collection; and to Dr. J. W. Folsom for literature and suggestions.

Family PODURIDAE Lubbock, Börner.

Subfamily Podurinae Börner.

Genus **Podura** (L.) Tullberg.

*Podura aquatica* L. On the surface of a pond. Gilbert: June 13. Ames: June 10, 1905, J. E. Guthrie.

Subfamily Achorutinae Börner.

Genus **Achorutes** Templeton.

*Achorutes armatus* Nic. Quite common and generally distributed. Ames: Under boards and in black cup fungus, *Urnula craterium*, April 2, 9; April 10, 1897, E. D. Ball; May 7, from fungus, *Morchella* sp. LeGrand: April 14, from *Urnula craterium* and *Sarcoscypha coccinea*; August 4, from grass roots.

*Achorutes copiosus* Folsom. In rotting wood. Ames: February 22.

*Achorutes harveyi* Folsom. LeGrand: October 27, from rotting wood, one specimen.

*Achorutes maturus* Folsom. Council Bluffs: September 11, beneath boards.

*Achorutes packardi* Folsom. Generally beneath bark. Ames: March 30; August 13. Ontario: May 3.

*Achorutes* (*Schöttella*) *glasgowi* Folsom. Under bark. Ames: June 3.

Genus **Xenylla** Tullberg.

*Xenylla gracilis* Guthrie (= *grisea* Axelson?). LeGrand: April 14, living socially under bark.

*Xenylla maritima* Tull. Beneath boards and rocks. Central City: August 11.

*Xenylla welchi* Folsom. Under bark of stump. Very numerous. Ames: April 3, 1907, J. E. Guthrie.

Subfamily Neanurinae Börner.

Genus **Friesia** Dalla Torre.

*Friesia* sp. Ames: June 13, 1910, J. E. Guthrie, beneath boards.

Genus **Neanura** MacGillivray.

*Neanura muscorum* Temp. Very common beneath bark and under debris. Ames: March 29; April 2, 7, 9, 26; May 7, 24; June 10; August 24; November 1.

\*—Contribution from the Department of Zoology and Entomology, Iowa State College, Ames,

Ontario: May 3. Tabor: September 15.

Subfamily *Onychiurinae* Börner.

Genus **Onychiurus** Gervais.

*Onychiurus armatus* Tull. Abundant beneath bark and litter. Ames: March 29; April 2, 9; June 28; July 13. LeGrand: April 14; August 18. Tabor: September 15.

*Onychiurus ramosus* Folsom. Beneath bark. Ames: March 30.

*Onychiurus pseudofimetarius* Folsom. Under boards. Ames: April 2.

Genus **Tullbergia** Lubbock.

*Tullbergia* sp. Ames: June 17, under matted grass.

Family ENTOMOBRYIDAE Rondani.

Subfamily *Isotominae* Börner.

Genus **Folsomia** Willem.

*Folsomia bidenticula* Guthrie. Beneath debris. Not common. Ames: March 30; April 6, 7; May 9.

*Folsomia fimetaria* L. Rather abundant under bark, stones, leaves, etc. One collection from cistern water. Ames: March 29, 30; April 5; May 5. Ontario: May 3.

*Folsomia fimetaria* var. *dentata* Folsom. One specimen from iris roots in which bulb flies were breeding. Ames: September 1.

Genus **Isotoma** Bourlet.

*Isotoma albella* Pack. A species characteristic of the under-bark fauna. Common. Ames: April 26; May 7; July 12; August 24.

*Isotoma cinerea* Nic. Often taken beneath bark with the above species. Ames: April 26, 28. LeGrand: April 14.

*Isotoma minima* Guthrie. Beneath bark and debris. Ames: April 3, 1907 and May 13, 1911, J. E. Guthrie; May 7, 9, 23; August 12.

*Isotoma arborea* var. *nigra* MacG. Under boards. Ames: May 13.

*Isotoma parva* MacG. A pretty, tiny species taken often with *I. albella* and *I. minima*. Ames: August 12. Central City: August 11. LeGrand: September 1. Tabor: September 15.

*Isotoma viridis* Bourlet. An abundant, large species. Found in sod, beneath debris, in decaying roots, under bark, etc. Conspicuous because of its large size and its activity. Ames: March 28; April 1, 2, 5, 6, 9; May 9, 23, 29; June 3, 10, 17; September 22, G. O. Hendrickson; November 1. LeGrand: April 14. Malvern: September 8. Tabor: September 15. Ontario: May 5, 20.

*Isotoma viridis* var. *riparia* Nic. Taken in wheat stubble. Malvern: September 10, 14.

Genus **Isotomurus** Börner.

*Isotomurus palustris* Muller. An abundant form along the edges of ponds and on the surface of water. Spirit Lake: April 7, 1905, H. E. Summers. Ames: May 27, 29; June 3, 14.

*Isotomurus palustris* var. *baltcata* Reuter. Ames: April 29, abundant in the insectary greenhouse and garden. Burlington: July, 1904, J. E. Guthrie.

Subfamily *Tomocerinae* Börner.Genus **Tomocerus** Nicolet.

*Tomocerus flavescens* var. *americanus* Schott. Taken beneath boards and among the roots of grass. Ames: April 1; June 17, 18; August 7. LeGrand: April 17, 18; October 27.

*Tomocerus flavescens* var. *separatus* Folsom. Ames: May, 1910, J. E. Guthrie. Burlington: July, 1904, J. E. Guthrie.

*Tomocerus vulgaris* Tull. Taken beneath debris and in damp cellar. Ames: April 7; May 13, 1911 and June 30, 1908, J. E. Guthrie. Central City: August 11. LeGrand: April 13. Tabor: September 15.

Subfamily *Entomobryinae* Börner.Genus **Entomobrya** Rondani.

*Entomobrya assuta* Folsom. A rather common species found under bark. Several specimens found in a fox squirrel's nest. Ames: April 7, 26; May 27; June 28; August 21, J. A. Kartchner. Central City: August 11. LeGrand: April 14.

*Entomobrya bicolor* Guthrie. A beautiful large species. Not abundant. Beneath grass mats, under bark, under codling moth bands. Ames: March 30; May 16, 23; June 10; August 18.

*Entomobrya griseo-olivata* Pack. Taken occasionally beneath bark. Ames: April 7, 10; May 23; June 14, 17; August 24. LeGrand: April 13; August 18.

*Entomobrya multifasciata* Tull. Taken abundantly wherever and whenever collections were made.

*Entomobrya purpurascens* Pack. Very common under bark. Generally taken with the above species.

Genus **Seira** Lubbock.

*Seira buski* Lubb. Abundant in the Insectary at Ames and occasionally under bark. Ames: March 30; April 1, 2; May 3, 27; June 12, 28; July 13; August 8. Marshalltown: August 17.

*Seira nigromaculata* Lubb. In much the same habitat as the above but seldom taken away from dwellings. Ames: March 29; April 1, 3, 7; June 12. Des Moines: August 15, 26. LeGrand: August 18. Washington: September 1, 1903, J. E. Guthrie.

Genus **Lepidocyrtus** Bourlet.

*Lepidocyrtus albicans* Reuter. Taken on moist water pipes in cellar. Central City: August 11.

*Lepidocyrtus cyaneus* Tull. Very abundant everywhere throughout the summer under boards, bark, etc.

*Lepidocyrtus sexoculatus* Guthrie. Under damp boards and in cellar. Ames: March 7, 28; April 20; June 30; J. E. Guthrie.

*Lepidocyrtus violentus* Folsom. The most common form in the soil. Abundant everywhere at all times.

Genus **Cyphodeirus** Nicolet.

*Cyphodeirus albinus* Nic. Taken only on decaying onions in the Insectary greenhouse. Ames: April 2; July 16; August 16.

Genus **Orchesella** Templeton.

*Orchesella ainsliei* Folsom. The most common species of the genus in the state.

Found under grass mats, bark, boards, etc. Ames: March 30; April 2; June 10, 17, 25; August 4; November 8; September 22, G. O. Hendrickson. Adel: September 4. LeGrand: April 14, August 18; September 1.

*Orchesella albosa* Guthrie. Taken with *I. palustris* and *Prosmithurus aquaticus* at the edge of ponds and on the surface of the water. Taken in a net from grass in a marshy pasture. Uncommon. Ames: May 8, 15, 20, 29; June 17.

*Orchesella zebra* Guthrie. Beneath bark, rare. Ames: August 8. LeGrand: April 14.

Family SMYNTHURIDAE Latreille.

Subfamily *Sminthuridinae* Börner.

Genus **Sminthurides** Börner.

*Sminthurides aquaticus* Bourlet. A common form on water. Often overlooked because of its small size. Ames: May 29; June 17. Gilbert: June 13.

Genus **Sminthurinus** Börner.

*Sminthurinus elegans* Fitch. From grass and from sod in peat bog. Ames: May 29, 1908, J. E. Guthrie; November 1.

*Sminthurinus niger* Lubbock. Beneath bark and under stones. Uncommon. Ames: May 5, 1910, J. E. Guthrie; May 7.

Subfamily *Smynthurinae* Börner.

Genus **Bourletiella** Banks.

*Bourletiella hortensis* Fitch. Very common in the spring. Ames: April 16; May 7, 8; August 27; May 28, 1908 and June 20, 1910, J. E. Guthrie. Ontario: May 3; June 12.

Genus **Smynthurus** Latreille.

*Smynthurus aureus* Lubbock. Not common. Taken from decaying cabbage roots and grass in the spring. Ames: March 28; April 6.

*Smynthurus caecus* Tull. Beneath leaves. Uncommon. Ames: July 25.

*Smynthurus dorsalis* Banks. Very commonly swept from rank grass. One of the most abundant species of the family in central Iowa. Adel: September 4. Ames: April 6; May 7, 8, 9, 20. Malvern: September 9, 17. Ontario: May 9; June 12.

*Smynthurus minnesotensis* Guthrie. Uncommon. Under bark. Ames: August 8.

*Smynthurus minutus* MacG. Uncommon. Burlington: July 1904, J. E. Guthrie.

*Smynthurus quadrimaculatus* Ryder. Beneath bark. Not common. Ames: November 1.

*Smynthurus spinatus* MacG. Taken with *Podura aquatica* and other water forms. Gilbert: June 13.

Subfamily *Dicyrtominae* Börner.

Genus **Ptenothrix** Börner.

*Ptenothrix marmoratus* Pack. Not uncommon under bark and decaying wood. Ames: November 8.

*Ptenothrix unicolor* Harvey. Common in decaying wood, beneath boards, under bark, etc. Ames: June 10, 14; August 18, 24; November 15. LeGrand: October 27.



## CONTRIBUTION TO THE BIOLOGY OF ONTARIO MAYFLIES WITH DESCRIPTIONS OF NEW SPECIES.

BY F. P. IDE,

## INTRODUCTION.

During the summers of 1928 and 1929 a study was made of the mayfly fauna of several streams and lakes in Ontario, particular attention being given to associating the nymphal stages with the adults by rearing them in cages set in the streams. In the course of the work the nymphs of twelve species, hitherto unknown in this stage, were found. These are described below. Three new species were taken and are also described.

In 1928 work was done at Horning's Mills early in the summer and at Glen Major and Inglewood later. In 1929 the mayfly fauna of Lake Nipissing was studied and some collections were made in Algonquin Park also.

## LOCALITIES AND HABITATS.

*Horning's Mills* is situated at the headwaters of the Pine river, a tributary of the Nottawasaga river in the Georgian Bay drainage area. The river has its origin in a number of spring-fed streams which flow over limestone, the stones in the water being encrusted with lime in many places. On some reaches of these streams the water is very rapid, almost torrential, in other places the streams broaden out, flowing more gently with occasional shallow rapids. At various places dams have been constructed causing the formation of small ponds.

One of these ponds, together with the stream below it and the stream flowing into it was made the subject of rather intensive study. The pond itself is about two acres in extent with two arms receiving the two inlet streams and one outlet at the mill dam. The east bank is fairly high and wooded with cedar, the west bank low and grassy with sedges along the shore. The greatest part of the bottom is covered with *Chara*, and *Potamogeton* grows up in groups here and there. The pond has a maximum depth of 7 feet, but the average depth is about five feet.

About fifty feet below the dam there is a fall of some fifteen feet and below this the stream is very rapid, flowing through a limestone gorge over broken fragments of rock with occasional falls and pools below them. The main feeding stream originates in springs in a small cedar swamp about half a mile above the pond and flows through open fields, cedar woods and open poplar woods to the pond. In the dense cedar woods the bottom is in general sandy and consequently almost devoid of vegetation and aquatic animal life. In more open places aquatic plants including water cress grow and the animal life shows a marked increase. In many places the stream widens out and becomes shallow forming shallow rapids with moss covered boulders in which locations the mayfly fauna is particularly abundant.

The water at the source had a pH of 7.4 which became 8.2 before it reached the pond and remained constant at this figure lower down the river. The oxygen content of the water varied from about 5.5 to 6.3 cc. per litre. The temperature of the water at the source was 7° to 9° C. Farther down stream it gradually rose but showed great change from day to day and also during the

day. Records taken at one time showed  $15.1^{\circ}\text{C}$ . above the pond,  $17.1^{\circ}\text{C}$ . below the pond and  $18.8^{\circ}\text{C}$ . about four miles down the river.

Other ponds in the vicinity are quite similar although usually somewhat larger, and the outlets of all join to form the Pine river. Collections were made in a number of these ponds and streams and also along the Noisy and Mad rivers, branches of the Nottawasaga river. The former is very similar in size and bottom to the Pine river and the latter is a slow-flowing deep stream with aquatic plants growing in profusion along the margins. Primrose, where collecting was also done, is situated on the Boyne river, a small stream, also a tributary of the Nottawasaga river.

*Glen Major* is situated on the divide between Lake Ontario and Lake Simcoe. The waters investigated here were three artificial trout ponds at the head waters of a small stream which flows south into Lake Ontario. The ponds are each about an acre in extent. The upper one is shallow (mostly under five feet), the middle one deeper (one fourth of it, five to ten feet deep), the lower one still deeper (two-thirds of it five to ten feet deep). The bottom is overgrown with *Chara* in most parts, with a little *Potamogeton* here and there. There are a few cold springs in the ponds augmenting the water of the feeding streams. The reaction of the water ranged from pH. 7.6 in one of the feeding streams to pH. 8.2 at the outlet of the lower pond with most of the water at a pH. of 7.8. The oxygen content of the water varied from about 5.5 cc. per litre at the inlets to over 7. cc. per litre at the outlets of the ponds. The temperatures in the ponds ranged from about  $13^{\circ}\text{C}$ . to  $16^{\circ}\text{C}$ . during August. The stream connecting the ponds was for the most part sandy with moss-covered stones in many places.

*Inglewood* is situated on the Credit river which flows into Lake Ontario at Port Credit. The pond studied here is the lowest in a series of artificial, spring-fed trout ponds, emptying into the Credit river. It has a maximum depth of about three and a half feet and an area of about two acres. The shores are low and lined with *Typha* sp. (cat-tails), and *Scirpus* sp., and the bottom is overgrown with *Chara* and a considerable amount of *Potamogeton*. On August 28th, the water contained 5.6 cc. oxygen per litre, gave a reaction represented by pH. 8.0 and the overflow water was at a temperature of  $24.5^{\circ}\text{C}$ .

*Lake Nipissing* is a large lake, about thirty miles long and half as wide, situated in Laurentian granite rock and emptying by the French river into Georgian bay. Some of the collections here were made around the shores of the lake and others up Sand creek, a small river flowing into the lake on the south side at Franks bay.

The surface temperature in the bay was fairly constant and always colder than in the stream. On June 14 it was  $14^{\circ}\text{C}$ ., rising slowly to a maximum of  $21^{\circ}\text{C}$  on June 20. About June 28 the surface temperature dropped to  $16^{\circ}\text{C}$ . and rose gradually, reaching  $19^{\circ}\text{C}$ . on July 11; and throughout the rest of the month the surface temperature fluctuated between  $19^{\circ}$  and  $21^{\circ}\text{C}$ . The temperature of the water about one quarter of a mile up the creek was  $18^{\circ}\text{C}$ . on June 9th and  $24^{\circ}\text{C}$ . on July 14th. The reaction of the water at the same location on July 7th was acid, giving a pH. of 6.9 and an oxygen content of 4.9 to 5.0 cc. per litre at a temperature of  $23^{\circ}\text{C}$ .

At *Algonquin Park* the collections made were mainly of adults whose nymphs lived in a short, rapid stream connecting two lakes, Ragged and Smoke. These lakes are two in a chain of lakes drained by the north branch of the Muskoka river and are thus in the Georgian Bay drainage area. The stream connecting them was very rapid in most of its course but widened out in places to form shallow rapids. On August 5 in the afternoon the water showed a pH of 7.4, contained 5.5 cc. oxygen per litre and was at a temperature of 18°C.

#### ACKNOWLEDGEMENTS.

I wish here to express my thanks and appreciation of assistance received during this work as follows, - to the Ontario Fisheries Research Laboratory of the University for financial aid which made the investigation possible; in the Department of Biology to Dr. E. M. Walker, under whose direction the work was carried out, and to Professor J. R. Dymond for advice and helpful criticism; to Dr. J. H. McDunnough of the Entomological Branch at Ottawa for assistance in identifying some of the adults and to Dr. W. A. Clemens of Nanaimo, B.C., who kindly supplied me with his bibliography and literature; finally to Mr. W. E. Ricker of the Department of Biology for data on the physical and chemical properties of the water.

#### ANNOTATED LIST.

An annotated list of the species taken follows. This list cannot, however, be regarded as at all complete for the localities represented since the time spent in each was too short to make this possible. Where two dates separated by a dash are given they represent the earliest and latest dates on which specimens were taken. The arrangement adopted in this list is that of Eaton (1883-8) with some modifications made by Ulmer (1920).

#### Subfamily Ephemerinae

*Ephemera simulans* Wlk. Lake Nipissing, 30, VI-24, VII, 1929.

This species was not very common but a series of imagos was taken around some of the islands in the middle of the lake.

*Hexagenia rigida* McD. Lake Nipissing, 11-25, VII, 1929.

These mayflies were very abundant and all the specimens collected were taken on the islands in the middle of the lake.

*Hexagenia limbata*, var. *occulta* Wlk. Lake Nipissing, 6-25, VII, 1929.

Very numerous and taken along with the preceding species.

*Hexagenia viridescens* Wlk. Lake Nipissing, 21, VI, 1929.

A mating swarm of this species comprising males and females was found up Sand creek about two weeks before any of the other species of this genus appeared. They were not plentiful.

*Hexagenia affiliata* McD. Lake Nipissing, 17, VII, 1929; Algonquin Park, 19-30, VIII, 1929.

In a small bay of the French river about a mile below the lake a large number of females of this species were found floating in the water, just at dark. No sign of swarming males was seen. A few specimens were also taken at Wolf and Smoke Lakes in Algonquin Park where they did not seem at all abundant.

Subfamily Bactinae

*Leptophlebia*. During the two summers of 1928 and 1929 we were fortunate in being able to associate the nymphs of five eastern species of *Leptophlebia* with their adults. Descriptions are offered below and also a key to these species. There are four additional eastern species, whose nymphs are still unknown, so that, in using the key, determinations should always be checked over by referring to the descriptions. The nymph of *L. praepedita* Eat. has been described by Needham (1905).

A. Gills with tracheoles branching from tracheae.

I. Main trachea of gill branching about  $2/7$  of distance from base  
*L. mollis* Hag.

II. Main trachea of gill branching about  $3/8$  of distance from base  
*L. adoptiva* McD.

AA. Gills without conspicuous tracheoles.

I. Main trachea of gill branching about  $1/7$  of distance from base  
*L. volitans* McD.

II. Main trachea of gill branching about  $1/10$  of distance from base.

(a) Second joint of maxillary palpus long, legs pale *L. guttata* McD.

(b) Second joint of maxillary palpus short, legs barred *L. debilis* Wlk.

*Leptophlebia volitans* McD. Algonquin Park, 6-22, VIII, 1929.

This delicate nymph was taken in the shallow water of the stream connecting Ragged and Smoke lakes. The adults were emerging and as this was the only species of this genus in the stream, nymph and adult are definitely associated.

McDunnough's figure of the male genitalia of this species accompanying the original description (McDunnough 1924) gives an erroneous impression so that a view of these parts in profile has been added in figure 1c, Plate I.

*Nymph*. Length of body 6.5 mm., caudal setae 3.5 mm.

See figure 1. Plate XVII.

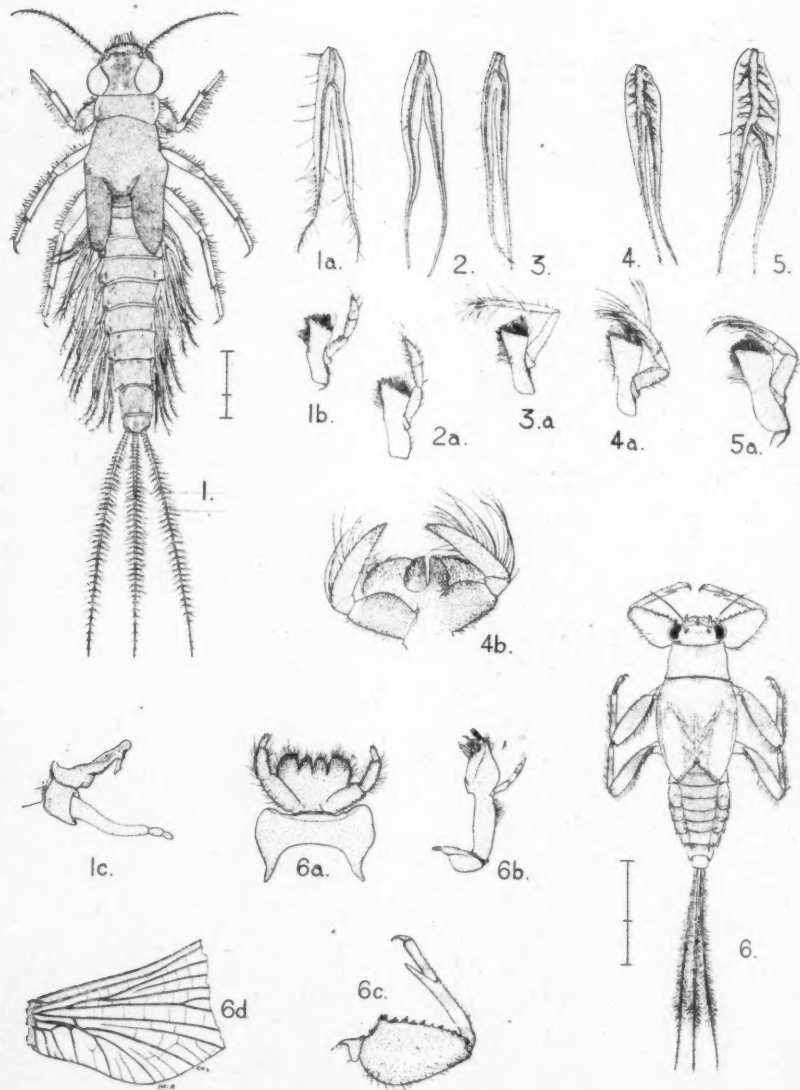
*Head*.—This nymph was just about to emerge and consequently shows the male eyes developed. Frons and vertex in front of eyes dark brown with pale spots over the ocelli; vertex between eyes paler brown with a medium pale line following the epicranial suture. Antennae pale brown and hairy; frons also with long hairs. Maxilla as in figure 1b, Plate XVII.

*Thorax*.—Pronotum dark brown with median pale line and pale lateral edges in the anterior two-thirds of the segment. Mesonotum uniform dark brown. Both prothorax and mesothorax with long hairs. Legs pale; prothoracic ones somewhat darker than others; dark shading distally in femora and proximally in tibiae and tarsi.

*Abdomen*.—Lighter brown dorsally than thorax. Segments 3-7 with a pair of sub-median pale spots in the anterior half of the segment and a pale median area on the posterior border of the segment; also a dark blackish longitudinal stigmatal dash laterally in the segment. Segments 8-10 lack the stigmatal dashes and segments 8 and 9 are provided with sharp postero-lateral spines; segment 10 has a pair of sub-median longitudinal pale areas. Caudal setae pale brown with joints darker; provided with hairs. Gills bilobed, the lobes very narrow

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PLATE 17.



BIOLOGY OF ONTARIO MAY FLIES



and acutely pointed and hairy as shown in figure 1a. Venter of abdomen pale, narrowly brown along the joints of the segments.

*Leptophlebia mollis* Hag. Horning's mills, 15, VI.-21, VII, 1928.

Nymphs of this species were very plentiful in nearly all the streams about Horning's Mills where they were found among the stones in the shallow water along the banks. The species was not reared but nymphs and adults were associated when subimagos were found emerging in great numbers in the late afternoon. The subimagos were kept until they became adult.

*Nymph.* Length of body, 6.5-7.5 mm.; caudal setae 4.0-4.5 mm.

This is a uniformly brown nymph with few short hairs.

*Head:*—Depressed; mouth parts directed anteriorly; mandibles visible from above, giving the head a rectangular appearance with its long axis the median line. A pale area between the ocelli and one in front of each ocellus. Maxillae pale and as shown in figure 4a, and labium as in figure 4b, Plate XVII.

*Thorax:*—Pronotum transverse and light brown with clear lateral margins. Mesonotum evenly light brown; wing pads darker. Legs pale, contrasting sharply with the rest of the nymph, sometimes slightly suffused with brown but not with brown bands.

*Abdomen:*—Uniformly brown in most specimens; sometimes, however, the segments darker towards their lateral borders and traces of a median band and a pair of sub-median pale spots. Venter pale medially, brown along lateral borders. Segment 8 shows practically no postero-lateral spine. Caudal setae pale and very sparsely clothed with short hairs. Gills as in figure 4, Plate XVII; main trachea branching about one-third of the way from the base of the gill; small tracheoles branching from the main trachea.

*Leptophlebia adoptiva* McD. Horning's Mills, 13 and 14, VI, 1928.

This is a large rather pale nymph which was found in a small stream at Horning's Mills, in company with *L. mollis* Hag. The species was not common, only one nymph and six adults having been taken. The nymph bears a resemblance to *L. mollis* Hag. in the structure of the gills, and the adults also show an affinity in the form of the male genitalia (McDunnough 1929).

*Nymph.* Length of body exclusive of caudal setae 1 cm.

*Head:*—Frons brown, pale areas in front of median ocellus and lateral to the lateral ocelli; vertex paler. Mandibles pale brown above; maxilla as in figure 5a, Plate XVII; labrum hairy. Antennae pale.

*Thorax:*—Pronotum with lateral margins converging from middle point forward; light brown with dark area in middle and inside this a spear-shaped pale mark. Mesonotum pale brown, slightly darker in the antero-lateral angles and on the scutellum. Legs entirely pale.

*Abdomen:*—Segments 2-7 dark brown with lighter lateral edges; a narrow median pale area extending back nearly to the posterior border of the segment and a pair of sub-median pale dashes diverging from the median line at the anterior border. Segments 8-10 brown; segment 8 without a distinct postero-lateral spine; segment 9 with a distinct rather stout postero-lateral spine. Venter pale medially with indistinct brown shading submedially. Caudal setae pale with short hairs. Gills as in figure 5, Plate XVII; the two lamellae separating nearly one half the distance from the base of the gill to the apex; the main

tracheae with numerous tracheoles which show more branching than those in *L. mollis* Hag.

*Leptophlebia guttata* McD. Primrose, 10, VII, 1928; Horning's Mills, 5-21, VII, 1928.

The adults of this species were plentiful along the Noisy and Pine rivers at Horning's Mills and the nymphs were found in the shallow water along the edges. On one occasion they were found emerging and nymphs and adults were associated. For a description of the adults see McDunnough (1924).

*Nymph.* Length of body, 6.5-7.0 mm.; caudal setae 7.5 mm.

This rather pale, slender nymph is readily separated from the other *Leptophlebia* nymphs by the long maxillary palpus.

*Head:*—Uniformly brown; antennae brownish. Mouth parts pale and maxilla as in figure 3a, Plate XVII.

*Thorax:*—Pronotum dusky brown with paler lateral borders. Mesonotum similar with darker areas at the shoulders, and in the antero-lateral angles. Legs entirely pale.

*Abdomen:*—Segments 1-7 brown with indistinct dark stigmatal spots at the bases of the gills. Segments 8-10 darker brown with indistinct median pale line; segment 8 without a postero-lateral spine and segment 9 with one. Venter paler. Gills as in figure 3, Plate XVII; very narrow lamellae; the trachea branching almost immediately it emerges from the abdomen, and with no tracheoles. Caudal setae as long as nymph, median one considerably longer than others; all pale suffused with brown at base.

*Leptophlebia debilis* Wlk. Horning's Mills, 21 and 23, VII, 1928; Glen Major, 10 and 13, VIII, 1928; Latour creek, Algonquin Park, 1, IX, 1929.

This species was not common in any of the localities visited. Adults were taken swarming at the Noisy river at 5.30 p.m. standard time on July 21. At Glen Major a few individuals were taken emerging and nymph and adult associated. The nymphs were among the stones of the rapids in the stream connecting the two lower ponds.

*Nymph.* Length of body 7-8 mm.

*Head:*—Uniformly brown; second joint of antenna brown, remainder pale, Maxilla as in figure 2a, Plate XVII.

*Thorax:*—Pronotum brown with pale median line. Mesonotum and wing pads uniformly brown. Legs pale with a distinct brown band in the femur about 2/3 of the way from the base, a brown band in the middle of the tibia and a smaller brown mark at its proximal end and a brown band at the base of the tarsus.

*Abdomen:*—Dorsum brown with numerous rather large pale areas which are quite variable in extent. Segment 7 shows fairly typical maculation as follows; a rather large pale area medially on the posterior border, lateral to this and not reaching the posterior border a pair of smaller round pale areas, a pair of small sub-median pale dashes diverging somewhat from the anterior border, near the lateral border and not reaching the anterior border another pair of small pale spots, lateral borders margined with a pale area which is narrow anteriorly and expands towards the base of the gills. On venter a narrow brown longitudinal band near the lateral border. Segments 8 and 9 both with distinct

postero-lateral spines. Gills with main tracheae dividing almost immediately they leave the abdomen; no tracheoles present (see figure 2, Plate XVII). Caudal setae (broken off in these specimens) pale.

*Leptophlebia praepedita* Eat. Horning's Mills, 5 and 24, VI, 1928.

Two adults of this species were taken along one of the small streams near the source of the Pine river.

*Leptophlebia moerens* McD. Horning's Mills, 5-25, VII, 1928.

A long series of this species was taken swarming during the early afternoon along the Pine river, about four miles from the source on July 5. Two individuals were taken on July 25, about half a mile from the source.

*Habrophlebiodes americana* Bks. Horning's Mills, 2-21, VII, 1928.

Nymphs and adults of this species were quite plentiful in the moderately rapid rocky stretches of the Noisy river and two adults were taken at Primrose also.

*Blasturus cupidus* Say. Lake Nipissing, 10-22, VI, 1929.

Plentiful in the quiet pools in Sand creek and also along the shores of Franks bay where the adults were reared.

*Blasturus nebulosus* Wlk. Horning's Mills, 15, VI.-5, VII. 1928; Lake Nipissing, 22, VI. 1929.

This species was common in the very weedy parts of the streams at Horning's Mills in the cold water near the source. It was not very common at Lake Nipissing where it occurred in the upper reaches of Sand creek.

*Ephemerella excrucians* Walsh. Horning's Mills, 19-27, VI. 1928.

Males of this species were quite commonly found in the evening in mating swarms. The females were taken ovipositing usually later in the evening. Nymphs were not found.

*Ephemerella invaria* Wlk. (typical). Horning's Mills, 27, VI. 1928. One pair was taken mating.

*Ephemerella invaria* Wlk. (large dark form). Horning's Mills, 6, VI.-11, VII. 1928.

The nymphs of the large dark form of this species were very plentiful in the upper reaches of the stream where they climbed about in moss covering the stones of the rapids. The adult males formed mating swarms at about 6.30 p.m. standard time and flew high, dropping down occasionally within reach of a net. Emergence took place from 2.30 to 4.00 p.m. standard time.

*Ephemerella aronii* Esb. Pet. Horning's Mills 16-27, VI. 1928.

This interesting *Ephemerella* was taken in the nymphal stage in the very cold reaches of the stream near the source in company with *E. invaria* but was rather rare. Female adults were later taken and associated with the nymphs. This constitutes a record for this species which up till now had been taken only in Alaska, Alberta and Quebec Labrador (Walley, 1930).

*Ephemerella deficiens* Morg. Primrose, 10, VII. 1928; Horning's Mills, Pine river 5, VII. 1928 and Noisy river 2, VII. 1928.

Both nymphs and adults of this little species were taken. They were more abundant in the warmer parts of the rivers.

*Ephemerella simplex* McD. Horning's Mills, 2, VIII. 1928. One male of

this species was taken.

*Ephemerella sordida* McD.? Pine river, 27. VII, 1928.

Several females were taken ovipositing and were identified somewhat doubtfully as this species by Dr. McDunnough.

*Ephemerella temporalis* McD. Horning's Mills, 1 male 27. VI. 1928; Sand creek and Lake Nipissing 15. VI.-21. VII. 1929.

A long series of these was bred out from nymphs in cages set in Sand creek and along the shore of the lake. The nymphs were very variable in colour pattern, some showing a distinct median pale band on thorax and abdomen. Emergence took place considerably earlier in the season up the stream than in the lake.

*Ephemerella bicolor* Clem. Horning's Mills, 15. VI. 1928; Lake Nipissing, 8-25, VII. 1929.

One imago was taken at Horning's Mills and the nymph was also found in one of the ponds. The species was very plentiful at Lake Nipissing particularly around some of the islands in the middle of the lake.

#### ***Ephemerella depressa* n. sp.**

Nymphs of this mayfly were found crawling about in the moss on submerged stones in the rapids near the source of the stream studied at Horning's Mills. Although many nymphs were placed in a cage we had very little success in rearing them, three female imagos and two female subimagos being the only specimens secured in this way. One female imago with egg mass attached was caught later on the wing. Emergence took place in the forenoon.

*Imago Female.* Length of body 6-7 mm., setae 8 mm., wing 10-11 mm.

*Head:*—Vertex rather ruddy brown, darker brown around the ocelli.

*Thorax:*—Pronotum with prominent median carina; dark piceous, pleura paler. Mesothorax dark piceous with paler areas on either side of the median line immediately in front of the scutellum and on the pleura at the bases of the wings. Femora brown, somewhat paler than the notum, the distal end very slightly darker than the proximal end; tibiae lighter yellowish and the tarsi yellowish white. Wings very vitreous with rather pale venation,  $Cu_2$  fused with 1st anal as shown in figure 6d, Plate XVII. although this character is not quite constant, two wings in the 12 examined showing the normal arrangement.

*Abdomen:*—First seven segments lighter piceous with an olive green tinge imparted by the greenish eggs. (If the individual had not oviposited the abdomen was usually quite blackish due to discoloration). Segments 8-10 somewhat darker, opaque and a very slight ruddy tinge on the pleura. Subanal plate rounded apically. Caudal setae white basally, somewhat brownish white distally.

*Subimago Female.* Smoky, not blackish, wings.

*Nymph.* Length of body 9 mm., caudal setae 7 mm.

This is a robust nymph rather depressed in form and widest across the mesothorax at the base of the wings (see figure 6, Plate XVII).

*Head:*—Very similar to *E. cornuta* figured by Morgan (1911); frons vertical, ending ventrally in a truncate shelf above the labrum; a distinct medially curving horn above each antennal base; a median sharp tubercle below the median ocellus; two rounded prominences over lateral ocelli, Labium as in figure 6a, maxilla as in figure 6b, Plate XVII.



*Thorax*.—Pronotum rectangular, its length contained 1.7 times in the width; pale in colour with darker brown markings. Mesonotum broad and the wing pads extending back to about the posterior border of the 4th abdominal segment. Front femur very stout with posterior border very convex and anterior border straight and provided with teeth; middle and hind femora broad and flattened, pale in colour with two indistinct brownish bands one about  $\frac{1}{3}$  of the distance from the proximal end and the other the same distance from the distal end, hairy on anterior and posterior borders; tibiae light with an indistinct dark band in the middle; tarsi light with proximal dark band.

*Abdomen*.—Segments 1-7 with their terga brown; segments 8-10 paler with dark markings as in figure 6, Plate XVII. Gills on segments 3-7; not elyroid on 3; dark brown with a central pale area, Caudal setae relatively long, hairy and pale.

*Holotype*.—Female Horning's Mills, Ont. 18. VII, 1928 (F. P. Ide). in Royal Ontario Museum.

*Paratypes*.—Two females, Horning's Mills, Ont. 16. VI. 1928 and 6. VII. 1928. (F. P. Ide), one in Canadian National Collection.

This species comes very close to *E. cornuta* Morg. but can be separated from the latter readily by the form of the fore femur which is much stouter and has a more convex posterior border, and in the shape of the maxillary palpus. In *E. cornuta* also there is no fusion of  $Cu_2$  and the 1st anal veins in the imago wing. On wing venational characters, namely, fusion of  $Cu_2$  with 1st anal for some distance, this species would fall in Needham's subgenus *Eatonella*. The nymph, however, has not the characters which separate the species of this group and further the wing venational character is not constant, two specimens showing no fusion of these veins in one wing. This character does not seem to be a good one to use for establishing a subgenus.

(To be continued)

## THE BIOTA OF NEWFOUNDLAND.

BY T. D. A. COCKERELL,

Boulder, Colo.

I have just received from Professor M. L. Fernald two papers of extraordinary interest, on "Some Relationships of the Floras of the Northern Hemisphere" (Proc. Internat. Congress of Plant Sciences, 2, pp. 1487-1507, 1929) and "Unglaciated Western Newfoundland" (Harvard Alumni Bulletin, Jan. 23, 1930, 6 pp.). He shows that a large part of Newfoundland remained unglaciated during the last (Wisconsin) continental glaciation, and consequently possesses a large relict flora of species which have persisted, probably with little or no change, since pleistocene times. In the second paper cited, Fernald says: "During the past summer . . . . . I spent practically all of July and August and part of September hunting for more of these endemic and relic species on or near the Long Range of Newfoundland, and . . . . . it is safe to say that my party . . . . . brought back more than 250 such species, many of them hitherto quite unknown anywhere in the world. These plants were excessively localized, growing as small colonies on mountain tablelands or crests or at lower levels on cliffs and gravelly barrens."



Where the flora is so peculiar, the insects must be similarly interesting. I find a great many beetles recorded from Newfoundland, but very few apparently confined to that island. Possibly the Newfoundland specimens have not always been very critically examined, their special interest not being appreciated. Is it not possible that some of the pleistocene (interglacial) species described by Scudder and Wickham will be found living in Newfoundland?

The bees should certainly show peculiar features, though the genera will be few. Some one should comb the literature for records of possible Newfoundland endemics, but more particularly, there should be an expedition following in the footsteps of Fernald, to collect the insects of the same region. While I am writing, it may be worth while to state that the species of *Bombus* reported by Frison (1929) as collected by myself in Alaska and Yukon Territory, were collected by my wife (W. P. Cockerell), and were so labelled. Another curious error is in the Proc. U. S. Nat. Mus., 75, Art. 5, p. 105, where Parker records that I collected *Bembix sayi* at St. Augustine, Florida. The specimen came from San Augustine (at the base of the Organ Mountains), New Mexico.

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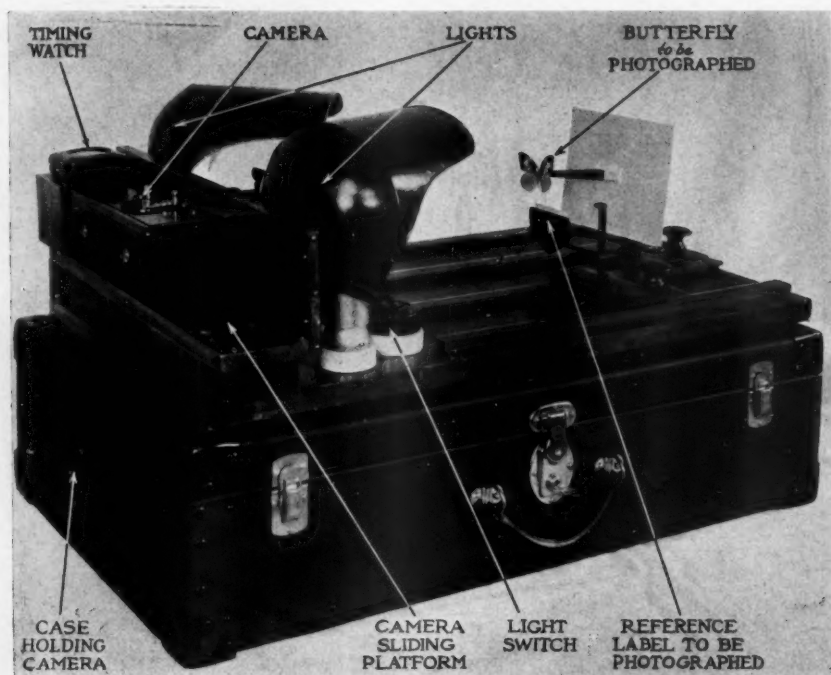
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*Size of butterfly as recorded on film*



*Butterfly enlarged to its original size*



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